COLORADO RIVER RECOVERY PROGRAM Project No.:_147_
FY 2006-2007 SCOPE OF WORK

Standardization of Recovery Program Electrofishing Fleet

Lead Agency: Colorado Division of Wildlife

Submitted by: Patrick J. Martinez

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Category:
____Ongoing
____Ongoing-revised project
__X_Requested new project
____Unsolicited proposal

Expected Funding Source:
____Annual funds
____Capital funds
__X_Other (Section 7)

I. Title of Proposal: *Standardization of Recovery Program Electrofishing Fleet*

II. Relationship to RIPRAP:

- General Recovery Program Support Action Plan
  - V.A. Measure and document population parameters to determine status and biological response to recovery actions.
  - V.A. 2. Evaluate population estimates.
  - V.C. Develop and enhance scientific techniques required to complete recovery actions.
  - V.D. Establish sampling procedures to minimize adverse impacts to endangered fishes.
  - V.D.2. Implement scientific sampling protocols to minimize mortality for all endangered fish.

III. Study Background/Rationale and Hypotheses:

The Colorado River Recovery Program consists of essentially six separate field stations conducting electrofishing in riverine critical habitat for endangered fishes and in adjacent river reaches. These stations include: U.S. Fish and Wildlife, Colorado River Fishery Project offices in Grand Junction, CO, and in Vernal, UT; Utah Division of Wildlife Resources offices in Moab and Vernal, UT; Colorado Division of Wildlife in Grand Junction, and the Larval Fish Lab at Colorado State University in Fort Collins.

Table 1 shows that each station has two to four boats that operate on one or more rivers each year to capture endangered, native or nonnative fishes.

Kolz (1989) developed a model of the transfer of power from water to fish which compensated for the power needed to deliver constant electric power to fish in waters with differing conductivities. This model is being used as a basis to standardize electrofishing in fishery research and management programs (Burkhardt and Gutreuter 1995, Chick et al. 1999, Miranda 2005). Bonar and Hubert (2002) elaborated the benefits of standardization for fisheries programs, including minimizing variation in catchability and maximizing catch. Standardizing the electrofishing fleet within the Recovery Program would promote and facilitate comparison of catch data among rivers and reaches, and may maximize the catch of target native or nonnative fishes, thus benefiting stock assessments or removal of target fishes.

Standardization of electrofishing in waters having differing conductivities is essential when monitoring temporal and spatial differences in fish assemblages (Miranda and Dolan 2003). This scenario is characteristic of work performed by the Recovery Program for Endangered Fishes in the Upper Colorado River Basin where periodic estimates of fish density and abundance are derived by electrofishing in several rivers known to have different water conductivities. Standardization of the amount of electrical power transferred to fish can reduce the variability of survey data and potentially reduce injury to fish (Miranda 2005). Burkhardt and Gutreuter (1995) improved the predictability of their electrofishing catch rates by adopting an electrofishing standardization protocol. Snyder (1995) cautioned that electrofishing-induced injury and mortality in sampled fishes can often be linked to excessive power levels.

Standardization of electrofishing equipment requires adjusting power output to keep constant the amount of power transferred to fish in diverse water conditions; however, this relationship can be affected by differences in electrode arrays (Miranda 2005). Further, the Recovery Program electrofishing fleet has switched primarily to Smith-Root GPP-5.0 electroshockers (Table 1) and some confusion may exist about the use of the percent of range control (Miranda and Spencer 2005). While complete standardization of an electrofishing fleet may not be entirely feasible, standardization of variables that can be accommodated by a fleet remains advisable (Miranda 2005).

The Recovery Program electrofishing fleet consists of both aluminum hull and inflatable boats fitted with boom electroshockers. Aluminum boat hulls can be used as the cathode for electrofishing systems (USFWS 2004), and this is the recommended method for DC and pulsed-DC systems as more of the available power becomes allocated to the anodes (FWS/NCTC 2005). Since the aluminum boats used for electrofishing tend to be of similar dimensions (16-18 feet long; Table 1), it is anticipated that they will be if similar electrical resistance, thus facilitating standardization, provided hull corrosion/anodization is minimal.

When an electoshocker is mounted on an inflatable or other non-conductive hull boat, a dropper or trailing cathode must be employed. While the cathode must be

referenced back into the electrofishing system, differences in the size, shape and amount of metal in the water may cause electrical resistance of the electrode array to vary considerably. Similarly, since inflatable-mounted electroshockers are typically reserved for low- or extreme-flow conditions, they may be used with only one spherical anode due to the power constraints of smaller outboards or rowing which may limit maneuverability. This reduced maneuverability may also require the electroshocker to be fitted with a smaller generator that may limit power output. This lesser similarity among inflatable-mounted electroshockers in the Recovery Program's electrofishing fleet makes it advisable and desirable to establish standardization among the aluminum-hulled boats so that this knowledge and protocol can be adapted to the more variable condition of the inflatables in the fleet.

IV. Study Goals, Objectives, End Product:

Goal

The goal of this Scope-of-Work is to provide members of the Recovery Program's electrofishing fleet with guidelines for standardizing their boats and electrode arrays to facilitate standardization of the power output of their electrofishing boats. This standardization is focused on the aluminum boats in the fleet operating with boom electroshockers. Upon standardization of the electrofishing boats themselves, a model specific to the conductivity range encountered by the Recovery Program electrofishing fleet in the upper Colorado River Basin (100-1000 µmhos) will facilitate setting electroshocker controls to achieve recommended power output to maximize fish capture while minimizing the likelihood of fish injury or mortality. Additional benefits of this process should be to reduce catch variability among boats and rivers, to improve comparability of data across rivers, reaches and species, and to maximize the catchability of target fishes.

Objectives

1. Establish "standard" electrofishing boat to which other boats in the fleet will be compared to evaluate the equivalent resistance of their electrode arrays.

2. Recommend electrode deployment, including anode (sphere) and cathode (boat hull) configuration, size and spacing to facilitate standardized electrical field and power output that can be accommodated by all boats in the fleet.

3. Evaluate all aluminum boats with boom electroshockers in the fleet to identify the equivalent resistance of their electrodes and recommend maintenance, modification or repairs required for individual boats to conform to the "standard" boat.

4. Evaluate spherical anode size relative to power output capabilities of electroshockers and develop model to recommend conductivity thresholds for changing anode size to optimize power output of electroshocker.

5. Explore response of electroshockers and their control settings to variable loads representing changes in water conductivity to assess their maintenance of expected waveforms in an attempt to identify any current properties that could pose a threat to fish exposed to the electrical field.

End Products

1. Standardized guidelines for deployment of electrodes including spacing, style, size, submersion and maintenance.

2. An evaluation of the equivalent resistance of the fleet's individual aluminum boats operating with boom electroshockers and recommendations needed for individual boats to conform to the "standard".

3. A model specific to the conductivity range encountered by the fleet's boats in Upper Colorado River basin recommending conductivity thresholds at which adjustments of electroshocker control settings or a switch to different diameter spherical anodes would be made to optimize power output.

4. Issue an alert, if necessary, to the Upper Basin fleet and to electroshocker manufactures if the variable load assessment identifies deleterious current properties that could pose a threat to fish exposed to the electrical field.

V. Study Area:

Work to establish "standard" boat for evaluation of equivalent resistance of electrodes, compare spherical anode sizes to power capabilities of electroshockers, and examination of electroshocker current properties under variable load will be performed in Grand Junction. Evaluation of the fleet's individual boats will be performed either in Grand Junction or at the respective field stations.

VI. Study Methods/Approach:

Larry Kolz, retired engineer – USFWS, will make electrical measurements and calculations (Kolz 1993) using the 18-foot CLARK aluminum flat-bottom boat operated by Lori Martin, aquatic biologist-CDOW, to establish the "standard" boat using fully submerged spherical anodes. Larry will perform, or train a designee, to conduct the assessment of equivalent resistance of the individual boats in the fleet. The evaluation of

individual boats will be performed in water of known conductivity, either in Grand Junction or at the Recovery program's stations in UT. A model specific to the conductivity range encountered by the fleet's boats in Upper Colorado River Basin recommending conductivity thresholds at which adjustments to electroshocker control settings or a switch to different sizes spherical anodes would be made to optimize power output. Larry will also simulate changes in water conductivity via incremental addition of resistors to examine current properties vs. the control settings of an electroshocker under load. This evaluation will allow examination of power output, but will also identify any changes in electrical waveforms that may deviate from specifications or that may be harmful to fish.

VII. Task Description and Schedule

Description

1. Establish "standard" electrofishing boat.

2. Recommend electrode deployment that can be accommodated by all boats in the fleet.

3. Evaluate electrofishing fleet for the equivalent resistance of their electrodes and make recommendations needed for individual boats to conform to the "standard" boat.

4. Develop model specific to conductivity range encountered by electrofishing fleet in rivers of the Upper Basin to guide selection of spherical anode diameter and electroshocker control settings.

5. Identify current properties of electroshocker output at various control setting when exposed to resistors simulating changing water conductivity.

VIII. **FY-2006 Work (first year of two-year project)**

Deliverables/Due Dates:

1. Specifications for fleet's "Standard Boat" (September 2006).

2. Model for Upper Basin water conductivity range recommending anode diameter and electroshocker control settings (September 2006).

3 Begin evaluation of conformity of individual boats in electrofishing fleet to "Standard Boat" (September 2006)

Budget
Labor: 180 hours @ $25/hour = $4,500
Travel: $500

TOTAL FY 2006 = Up to $5,000

FY-2007 Work (second year of two-year project)

Deliverables/Due Dates:

1. Evaluation of electroshockers under variable resistors (December 2006)

2. Presentation to Upper Basin Researchers Meeting (January 2006).

3. Complete evaluation of conformity of individual boats in electrofishing fleet to "Standard Boat" (April 2007).

4. Prepare report of findings (July 2007).

Budget
Labor: 180 hours @ $25/hour = $4,500
Travel: $500

TOTAL FY 2007 = Up to $5,000

IX. Budget summary

2006	up to $5,000
2007	up to $5,000
Total	up to $10,000

X. Reviewers:

Lori Martin, Colorado Division of Wildlife
Larry Kolz (retired USFWS), National Conservation Training Center

XI. References

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Bonar, S. A., and W. A. Hubert. 2002. Standard sampling of inland fish: benefits, challenges, and a call for action. Fisheries 27(3):10-16.

Burkhardt, R. W., and S. Gutreuter. 1995. Improving electrofishing catch consistency by standardizing power. North American Journal of Fisheries Management 15:375-381.

Chick, J. H., S. Coyne, and J. C. Trexler. 1999. Effectiveness of airboat electrofishing for sampling fishes in shallow, vegetated habitats. North American Journal of Fisheries Management 19::957-967.

(FWS/NCTC) Fish and Wildlife Service/National Conservation Training Center. 2005. Principles and techniques of electrofishing. U. S. Department of the Interior, Shepardstown, West Virginia.

Kolz, A. L. 1989. A power transfer theory for electrofishing. U.S. Fish and Wildlife Service Technical Report 22:1-11.

Kolz, A. L. 1993. In-water electrical measurement for evaluating electrofishing systems. U.S. Fish and Wildlife Service Biological Report 11.

Miranda. L. E. 2005. Refining boat electrofishing equipment to improve consistency and reduce harm to fish. North American Journal of Fisheries Management 25:605-618.

Miranda, L. E. and C. R. Dolan. 2003. Test of a power transfer model for standardized electrofishing. Transactions of the American Fisheries Society 132:1179-1185.

Miranda, L. E., and A. B. Spencer. 2005. Understanding the output of a Smith-Root GPP electrofisher. North American Journal of Fisheries Management 25:848-852.

Snyder, D. E. 1995. Impacts of electrofishing on fish. Fisheries 20(1):26-39.

(USFWS) U.S. Fish and Wildlife Service. 2004. Chapter 6: electrofishing. Occupational Safety and Health. FWM 442:242 FW 3, 6,8.

Table 1. Summary of aluminum-hull boats in Colorado River Recovery Program electrofishing fleet, May 2006.

Station	Boat mfg.	Name/description	Length	Shocker
CDOW Gr.Jct.	**Clark**	**Martin, flat bottom**	**18'**	**GPP-5.0**
	Clark	**Elmblad, flat bottom**	**18'**	**GPP-5.0**
	Clark	**Chaser, flat bottom**	**17'**	**GPP-5.0**
CSU - LFL	**Clark**	**Disco-Valante, semi-V**	**16'**	**GPP-5.0**
	Clark	**Deja vu, semi-V**	**16'**	**VVP-15**
	Clark	**Sea Monkey, semi-V**	**17'**	**GPP-5.0**
UDWR Moab	**Waterman**	**jon-boat, flat-bottom**	**16'**	**GPP-5.0**
	Waterman	**jon-boat, flat-bottom**	**16'**	**GPP-5.0**
UDWR Vernal	**?**	**?**		**GPP-5.0**
	?	**?**		**GPP-5.0**
USFWS Gr.Jct.	**Clark**	**semi-V**	**17'**	**GPP-5.0**
	?	**War Wagon I**	**16'**	**VVP-15(B)**
	?	**War Wagon II**	**16'**	**VVP-15(B)**
USFWS Vernal	**Lowe**	**Roughneck, ?**	**17'**	**GPP-5.0**
	Lowe	**Roughneck, ?**	**17'**	**GPP-5.0**
	Monark	**?**	**16'**	**GPP-5.0**
	Monark	**?**	**16'**	**GPP-5.0**